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tion took place. The pupa period remained about the same as normal, whence the conclusion is reached that regeneration takes place during the caterpillar stage and differentiation during the pupa stage. In the castrated series, in which the wing anlage was removed, it was found that the wing developed its normal sex character, although no sex cells were present. There was a difference in the amount of regeneration just as in the control series. Likewise in males with transplanted ovaries, the regenerated wing was of the normal male type, and exactly corresponded with its unregenerated mate.

From these experiments Meisenheimer concludes that in these moths primary sex cells have no influence on secondary sex characters or on sexual instinct. He therefore does not agree with the theory that internal secretions from the sex glands affect the soma. Both primary and secondary sexual characters are to be traced back to the young germ cells, since the secondary are not influenced by the primary during ontogeny.

E. N. Browne.

ANTS

The last number in the Columbia Biological Series is a volume by W. M. Wheeler[1] on ants. It is the largest number in the series, containing nearly 700 pages, but the unusual interest of the subject justifies the size of the publication. After an introductory account of ants as dominant insects, the author devotes several chapters to their structure and development. Then follows a discussion of polymorphism in which the interesting problem of the non-reproductive worker in relation to heredity is fully elucidated. After this come chapters on the classification and distribution of ants and on their geological history. The remainder of the body of the text contains a most fascinating account of the habits of ants. Following a consideration of the habits of ants in general, of nest-building and of the ponerine ants, the most primitive and generalized type of modern ants, is a succession of chapters on special habits and relations. These include accounts of the driver ants, the Huns and Tartars of the insect world; the harvesting ants, which, though they are grain-gatherers, are not strictly speaking grain-planters; the fungus-growing ants, whose subterranean fungus-gardens are fully described and beautifully illustrated; the honey ants, some of which serve their colonies as living receptacles for stored sweets; and, finally, the slave-making ants, which in extreme cases come to be absolutely dependent upon their captive workers.

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[1] Wheeler, W. M., "Ants, their Structure, Development and Behavior," New York, The Columbia University Press, 1910, pp. xxv + 663; 286 figs.

In appropriate places between the various chapters on these special groups are interpolated chapters on the supposed mutualism of ants and vascular plants, on myrmecophiles, of which among arthropods alone 1,500 species are known, on parasites, and on compound nests. The portion of the text dealing with the habits of ants is concluded by three remarkable chapters on the sensations, and instinctive and plastic behavior of ants, which, as a body of mature judgments on this most subtile field of animal investigation, is of the highest order. Any one who wishes to reach sane conclusions in the study of the habits of ants should ponder these chapters with care. The volume contains five excellent appendices: the first, on methods of collecting and studying ants; the second, a key to the subfamilies, genera and subgenera of North American Formicidæ; the third, a list of the described ants of North America; the fourth, on the extermination of noxious ants; and finally, a bibliography of over 2,000 titles. An ample index brings the volume to a close.

The brief outline of the subject matter of the volume as already given indicates the breadth of treatment accorded the material by the author. As a result the volume ought to find numerous readers beyond the professionals. Its pages throw many side-lights on human affairs which show that the sluggard is not the only one that might profit from the ant. Although the volume is based upon the studies of a world-wide range of myrmecologists, the reader is met at every turn with the author's extensive and intimate first-hand acquaintance with his subject. This acquaintance gives his critical comments unusual value.

In a book of such high general excellence it might seem ungracious to point out minor defects. As a matter of fact, however, the few that were noticed served only to increase the initial impression of thoroughness and accuracy. The illustrations, which are of the same high order as the text, are occasionally without any indication as to magnification (original Figs. 35, 37, 38, 39, etc.), and in a few other instances omissions occur, as in Fig. 271, in which the descriptive lettering of the legend is not repeated in the figure. In the text on page 108 *giantism* is probably a slip for the more usual *gigantism*. But even such slight defects as these are rare and the book presents an unusually clean appearance for a first edition. The treatment of the subject is so masterly and the material make-up of the volume so excellent that the biologists of this country may well look with pride upon this work as an American product.

G. H. Parker.